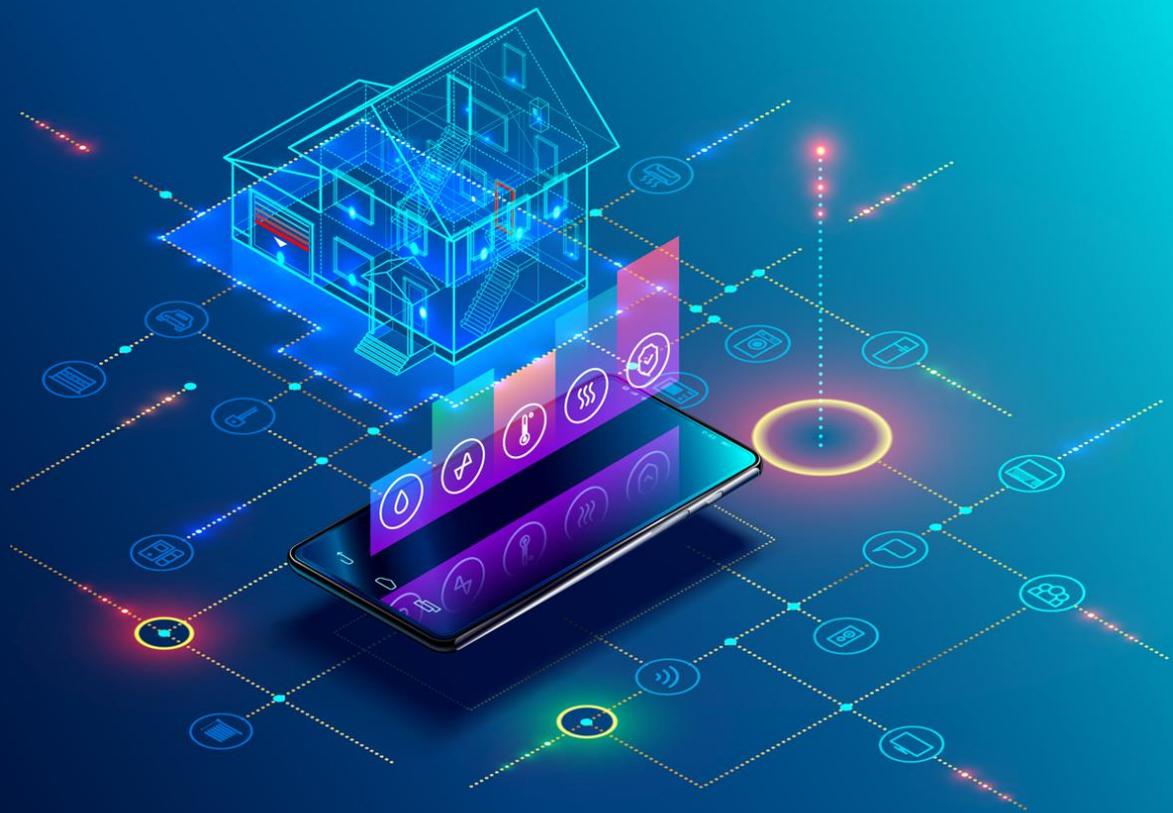


Method and Online Tool for Defining the Feasibility and Scope of BIM Implementation for Renovation Projects

Deliverable Report D2.1



Deliverable Report D2.1

BIM-SPEED

Harmonised Building Information Speedway for Energy-Efficient Renovation

This research project has received funding from the European Union's Programme H2020-NMBP-EEB-2018 under Grant Agreement no 820553.

Disclaimer

The contents of this report reflect only the author's view and the Agency and the Commission are not responsible for any use that may be made of the information it contains.

Method and Online Tool for Defining the Feasibility and Scope of BIM implementation for Renovation Projects

Deliverable Report D2.1

Issue Date	2019-11-01
Produced by	Planen-Bauen 4.0 Gesellschaft zur Digitalisierung des Planens, Bauens und Betriebens mbH
Main author	Mohamed Matook
Co-authors	Eike Tauscher, Jan-Derrick Braun, Oskar Bell Fernández, Piotr Dymarsky, Agnieszka Łukaszewska, Xabier Gesalaga, Paul Stupin, Essam Fadel
Version:	Final
Reviewed by	Timo Hartmann (TUB)
Approved by	Timo Hartmann (TUB)
Dissemination	Public

Colophon

Copyright © 2019 by BIM-SPEED consortium

Use of any knowledge, information or data contained in this document shall be at the user's sole risk. Neither the BIM-SPEED Consortium nor any of its members, their officers, employees or agents shall be liable or responsible, in negligence or otherwise, for any loss, damage or expense whatever sustained by any person as a result of the use, in any manner or form, of any knowledge, information or data contained in this document, or due to any inaccuracy, omission or error therein contained. If you notice information in this publication that you believe should be corrected or updated, please get in contact with the project coordinator.

The authors intended not to use any copyrighted material for the publication or, if not possible, to indicate the copyright of the respective object. The copyright for any material created by the authors is reserved. Any duplication or use of objects such as diagrams, sounds or texts in other electronic or printed publications is not permitted without the author's agreement.

This research project has received funding from the European Union's Programme H2020-NMBP-EEB-2018 under Grant Agreement no 820553.



Change log

Description	Author	Date
Initial version for internal review	Mohamed Matook, Eike Tauscher	30.09.2019
Addressing the internal review comments for final technical and administrative check	Paul Stupin, Eike Tauscher	31.10.2019
Final Technical editing	Paul Stupin, Eike Tauscher	01.11.2019
Addressing the review comments	Essam Fadel	02.09.2021

Publishable executive summary

Overview

The type of deliverable 2.1 is “other”, nevertheless, the partners contributing in this task decided to present a concise report to shed some light on different aspects of the deliverable.

This accompanying report aims at explaining deliverable 2.1: method and online tool for defining the feasibility and scope of BIM implementation for renovation projects. The main aim of this deliverable is to give guidance to stakeholders regarding BIM implementation in renovation projects on the basis of their respective level of BIM maturity. This is achieved through an online tool that guides the stakeholders to BIM use cases that are tailored to their respective level of BIM maturity. The tool allows the stakeholders to identify their own level of BIM maturity and provides an assessment of the feasibility of adopting one of the suggested BIM use cases based on available project information and the calculated BIM maturity level. The BIM maturity level is identified through an initial questionnaire, which is built upon existing BIM maturity indices, e.g., the BIM Quickscan (Netherlands) InfraBIM Maturity Metric (Germany). The BIM use cases are suggested based on a second questionnaire, which defines the project related information such as the renovation aim and size of the project.

The online tool consists of two main parts, the organization part and the project part. In the organization part the stakeholder gives, as input, the general information concerning his/her organization. This is followed by a questionnaire that aims at defining the BIM maturity of the respected stakeholder. In the project part, the online tool provides the stakeholder with BIM use cases that fit the given project. The information of the given project is identified through a project questionnaire.

The main output of this tool is BIM best practices and suggested BIM use cases along with their feasibility with respect to the level of BIM maturity of the stakeholder. WP4, namely T4.1 is highly relevant to this deliverable as one of the main outputs is a first set of suggested BIM use cases. In addition, D5.4 is also connected to this deliverable as it uses the outcome of the feasibility study to suggest BIM procurement strategies, protocols for collaboration and quality management guidelines.

The presented online tool is a preliminary version, which, once it is tested, will be developed and accurately calibrated by different stakeholders and consortium partners and extended for additional use cases that will be developed during the BIM-Speed project.

Deliverable 2.1 summary

Deliverable of the task T2.1

The type of this deliverable is "Other": a website (source code) and an additional report (not part of the deliverable)

The due date is M12:

First draft is on 30.09.2019

Final draft is on 24.10.2019

Final submission is on 31.10.2019

Task leader:

planen-bauen 4.0 Gesellschaft zur Digitalisierung des Planens, Bauens und Betriebens mbH (PB40)

Task partners:

Hochtief ViCon (HTV)

Fasada (FAS)

Mostostal Warszawa (MOW)

LKS Ingenieria (LKS)

Visesa (VIS)

List of acronyms and abbreviations

BIM: Building Information Modelling

BEM: Building Energy Model

UC: Use Case

HVAC: Heating Ventilation Air Conditioning

Definitions

BIM maturity index

BIM performance benchmarking for organizations and/or projects.

BIM passport:

BIM Passport reports the state of completeness of a digital equivalent of the existing residential building stock. It visualizes the quality of information within a BIM model.

Renovation goal:

Goals to be achieved (e.g., reducing energy consumption)

Business processes:

Tasks to be performed in design and construction projects (e.g., energy analysis)

BIM Use Case:

Use of BIM to support business processes (e.g., BIM based energy analysis)

Methods:

The way of working to serve BIM use cases (e.g., transfer BIM to BEM)

Framework:

The organizational, technical and legal requirements to run business processes.

Contents

1. INTRODUCTION	8
2. METHOD	8
2.1 Workflow	8
3. BIM USE CASES	10
4. ONLINE TOOL OBJECTIVES	11
5. ONLINE TOOL STRUCTURE	12
5.1 Enterprise Part	12
5.1.1 General Information	12
5.1.2 BIM-SPEED BIM Maturity Index	14
5.1.2.1 How is it Calculated?	15
5.2 Project Part	16
5.2.1 Identification of Use Cases	16
5.2.2 Project Questionnaire	18
5.2.3 Mapping Project Questionnaire to BIM Use Cases	20
6. ONLINE TOOL OUTPUT	25
6.1 Feasibility of BIM Use Cases	25
7. IMPLEMENTATION	26
8. REFERENCES	37
9. APPENDIX 1 – BIM-SPEED - BIM MATURITY QUESTIONNAIRE	39
10. APPENDIX 2 - REVISIONS ADDRESSING MONITOR COMMENTS	49

Table of Figures

Figure 1 Online tool – general workflow	8
Figure 2 Online tool – general workflow and survey parts	9
Figure 3 online tool - general flowchart	9
Figure 4 Radar Chart compared to Bar Chart Example	16
Figure 5 BIM-SPEED terminology	16
Figure 6 Top-Down Approach	17
Figure 7 Bottom-Up Approach	17
Figure 8 Requirement's approach vs Feasibility approach	18
Figure 9 Question Tree	21
Figure 10 Generic tree path	21
Figure 11 Simplified tree	22
Figure 12 Use Case Container – example UC2	23
Figure 13 Information container related to the BIM method – example BIM-to-BEM	24
Figure 14 Example of the feasibility of using UC2	25
Figure 15 External Landing page	26
Figure 16 Registration page	26
Figure 17 Registration successful page	27
Figure 18 Registration email confirmed page	27
Figure 19 Login page	28
Figure 20 Internal landing page after login	28
Figure 21 Internal personal settings page	29
Figure 22 Internal company settings page	29
Figure 23 Company BIM Maturity overview page	30
Figure 24 Company BIM Maturity questionnaire page – example	30
Figure 25 Company BIM Maturity questionnaire page – example	31
Figure 26 Company BIM Maturity questionnaire done page	31
Figure 27 BIM Maturity result page (1/3)	32
Figure 28 BIM Maturity result page (2/3)	32
Figure 29 BIM Maturity result page (3/3)	33
Figure 30 Projects overview page	33
Figure 31 Projects create page	34
Figure 32 Projects overview page – after project creation	34
Figure 33 Project questionnaire / use case page (1/3)	35
Figure 34 Project questionnaire / use case page (2/3)	35
Figure 35 Project questionnaire / use case page (3/3)	36

1. Introduction

Many stakeholders and building owners across Europe are not familiar with the application of BIM to support renovation projects. These stakeholders strive to take advantage of BIM, but cannot navigate their way around BIM. Therefore, BIM-SPEED aims at paving the way for whoever is interested in taking advantage of the application of BIM within renovation projects. This is accomplished by providing stakeholders with proposals for appropriate BIM use cases. These proposed BIM use cases will be provided by the online tool based on the level of BIM maturity of the stakeholder and the main objectives of the project defined by the stakeholder as input for the online survey. In addition, the user will be provided with appropriate BIM procurement strategies, protocols for collaboration and quality management guidelines (T5.4) after conducting the initial survey. The output of this tool will also serve as an input to develop renovation strategies for the demonstration cases of WP8.

2. Method

This study used a cross-sectional survey design to assess BIM maturity to the BIM use cases, of a sample of stakeholder executives. The research design was a correlational design utilizing cross-sectional survey methodology and includes a number of survey instruments. The purpose of the design was to correlate the scores of the BIM maturity tests listed below with the scores on responses to the BIM use cases.

2.1 Workflow

The main workflow of the online tool captures the information of a stakeholder via two types of questionnaires, processes it and delivers as results the correct BIM best practices and BIM use cases and their feasibility. **Figure 1** shows the general workflow of the online tool.

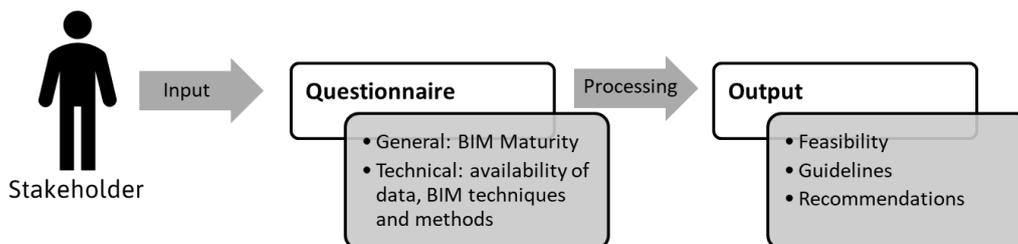


Figure 1 Online tool – general workflow

More precisely, the online tool consists mainly of two parts, the enterprise part and the project part. The enterprise part is concerned with gathering the general information of the stakeholder and the BIM maturity questionnaire. The project part allows the stakeholder to seek guidance about adequate BIM use cases for renovation measures as can be seen in **Figure 2** and **Figure 3**.

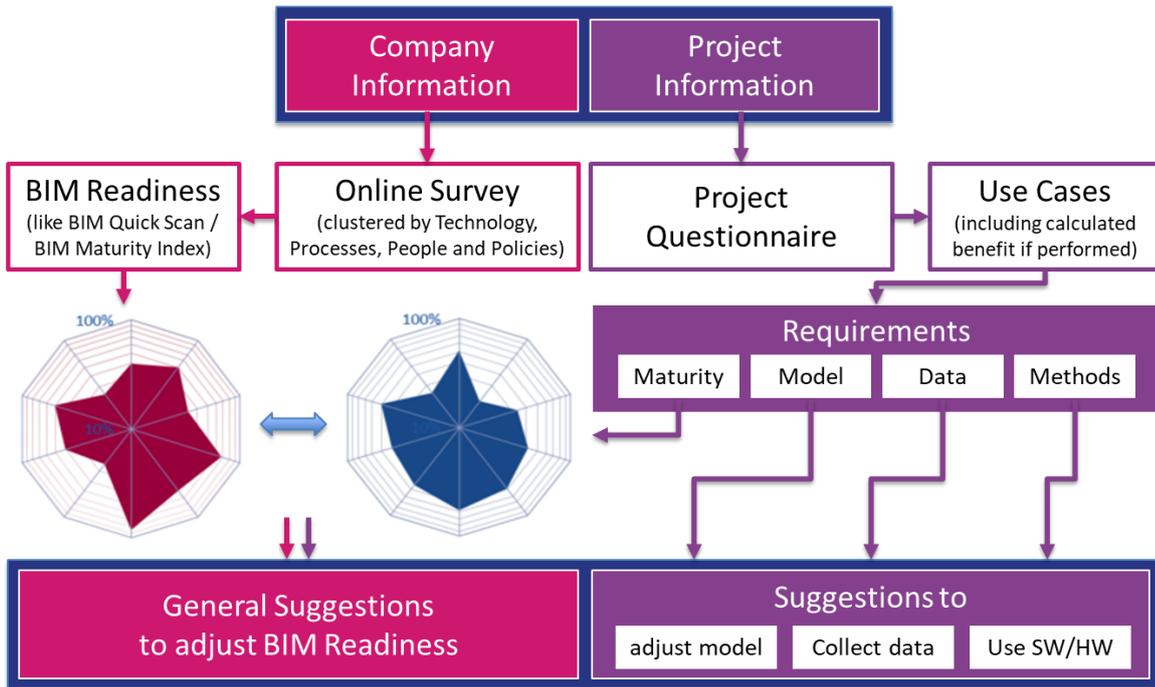


Figure 2 Online tool – general workflow and survey parts

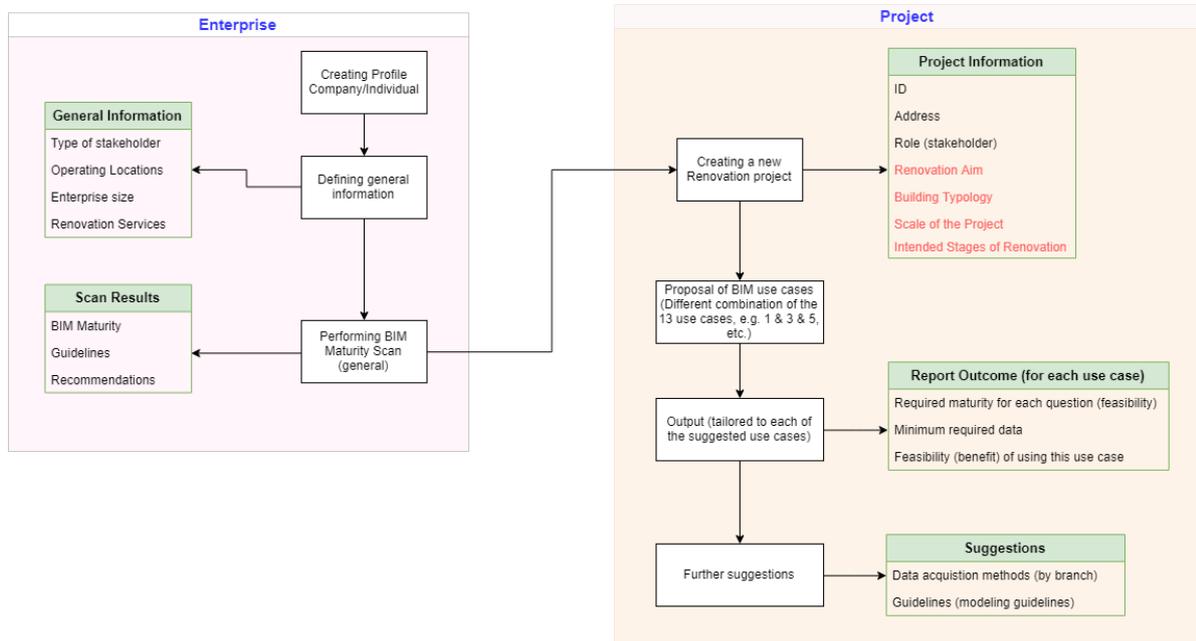


Figure 3 online tool - general flowchart

3. BIM Use Cases

Depending on the answers obtained from the project questionnaire presented in Chapter 5.2.2, selected predefined BIM use cases will be proposed by the tool. The selection of the use cases is related with renovation goals and scenarios and is described in Chapter 5.2.1. Depending on the plan for the intervention on the building various sets of BIM use cases will be proposed. For every use case that is suggested for the stakeholder, it will be clear what input information related to the renovation project is required. At the present time the following BIM use cases can be proposed by the tool shown in **Table 1**, for the full definitions of the use cases, please refer to D4.1 Baseline and Use-cases for BIM-Based Renovation projects and KPI's for EBB renovation. The Use-cases number are indicated within the table below.

No	BIM Use case	Short description	Requested input information
1	Assessing Building Energy Performance with simulated data (Use case no 2.)	The use case presents a procedure to obtain the energy model of the building (BEM) which provides the energy performance assessment. In addition, the UC specifies the steps to move from the real building to the virtual building: 1) Geometrical and systems data; 2) BIM Modelling; 3) BIM-to-BEM approach; 4) BEM Modelling.	<ul style="list-style-type: none"> - General information concerning the building (e.g., location, year of construction, floor area, number and type of occupants); - Schedules (e.g., occupancy, lighting, appliance); - Materials and stratigraphy.
2	Assessing Thermal Comfort with simulated data (Use case no 4.)	The use case provides a methodology for evaluating thermal comfort under different conditions: 81) During the heating season; 2a) During the cooling season with cooling system; 2b) During the cooling season without cooling system.	<ul style="list-style-type: none"> - Start of heating season; - End of heating season; - Start of cooling season; - End of cooling season; - Occupied days; - Net floor area; - Number of rooms. <p>Not mandatory data:</p> <ul style="list-style-type: none"> - PMV index (which can be obtained with the following variables: Air Temperature, Mean Radiant Temperature, Air Velocity, Relative Humidity, Metabolic Rate and, Clothing Level). <p>For calculating the thermal comfort during the cooling season without cooling system (condition 2b) the following further variables are needed:</p> <ul style="list-style-type: none"> - Air Temperature; - Mean Radiant Temperature; - Outdoor Temperature.
3	Assessing Acoustic Comfort with simulated data (Use case no 6.)	The use case provides a methodology to obtain an overall assessment of the acoustic comfort of the building. The key output is the acoustic classification of the building.	<ul style="list-style-type: none"> - Floor area of each room adjacent to the external environment; - Room end use; - Indoor A-weighted equivalent sound pressure level. <p>N.B. The analysed rooms are only those bordering to the external environment.</p>

4	Assessing the as-built Indoor Air Quality with simulated data (Use case no 8.)	This use case provides the methodology to simulate and assess the level of indoor air quality with respect to requirements suggested by actual standards	- Indoor CO2 concentration simulated in all rooms [ppm] - Outdoor average CO2 concentration [ppm] - Geometrical data of the building
5	Lighting and Visual Comfort Analysis with simulated data (Use case no 10.)	The use case provides a methodology for evaluating Visual comfort under different conditions: 1) Throughout specific/ determined timeline (yearly, monthly, daily); 2) Within specific geo-location; 3) Within physical constraints (window to wall ratio, spatial depth, interior lighting, shading, material passport etc.).	- Digital model of the building with context, surface definition and material, topography, and geographic coordinate (for solar analysis accuracy) - Fully integrated Light sources and intensity levels (in 3D model matching the analysed building conditions) - Sensors, and site analysis data definition in the 3D model for the focus area of investigation.
6	Assessing operational energy cost and payback (Use case no 16.)	The use case aims to calculate the simulated operational cost per square meter and the renovation payback.	- Simulated operational energy cost (per each design option) - The apartment area (was any area added during the renovation?) - Renovation budget - Total Energy Savings (Operational energy cost before renovation Simulated operational energy cost)

Table 1 BIM Use Cases

4. Online Tool Objectives

The targeted use of this tool is possible for all stakeholders, involved in renovation projects, who are interested in approaching the renovation with BIM-based methodologies.

To meet the stakeholder requirements, and understand their objectives need, a feasibility study has to be conducted,

- A feasibility study is an assessment of the practicality of a proposed project or system. A feasibility study aims to objectively and rationally uncover the strengths and weaknesses of an existing business or proposed venture, opportunities and threats present in the natural environment, the resources required to carry through, and ultimately the prospects for success.

Followed by identifying the project scope, where in project management, and for this tool

- Scope is the defined features and functions of a product, or the scope of work needed to finish a project, scope also involves getting information required to start a project, including the features the product needs to meet its stakeholders' requirements.

The two main objectives of the online tool are to determine the feasibility of the stakeholder's company of using BIM for renovation projects and to define the scope of stakeholder best estimated BIM implementation for renovation projects. Defining the feasibility does not stand for informing the user whether it makes sense to use BIM within renovation projects or not, but rather providing guidance on which BIM use cases are best suited after considering the BIM maturity of the interested user and the project-specific information. Defining the scope of BIM implementation is presented by comparing the stakeholder's feasibility, and the BIM use-cases requirements, and showing which areas has a lack of maturity.

5. Online Tool Structure

This chapter describes the structure of the developed online tool as well as the internal processes.

5.1 Enterprise Part

As mentioned before, the Enterprise Part aims at gathering the general information from the stakeholder (company) and identifying the level of BIM maturity through a BIM maturity questionnaire. The online tool will ask each user to register his/her company in the system and enter all of the relevant general information concerning the company. This needs to be done only once with the possibility to modify the information at will. Likewise, the BIM maturity questionnaire only needs to be completed once to define the BIM maturity level. Of course, it is also possible to undertake the questionnaire more than once. To keep the online tool under constant improvement during the BIM-SPEED project, the online tool includes open questions to ensure circulating constructive feedback from the user. This helps to modify or introduce new questions to the questionnaires.

5.1.1 General Information

If a user decides to make use of the online tool, a short list of questions needs to be answered. These questions are shown in **Table 2**. The purpose of obtaining this information has, at the moment, provides a calculated maturity index, with no effect on the outcome of the project questionnaire provided by the tool. However, this information might be useful for later stages of the project as there are different tasks within the BIM-SPEED project that depend on this online tool, e.g., guidelines for BIM-based procurement, collaboration protocols and IPD for renovation projects (D5.4).

Name	
Body	Private
	Public
Address	Street
	Number
	Post code
	City
	Province/State
	Other: _____
Activity field	Architecture
	Engineering consultancy
	Surveying
	Construction
	Other: _____
Type of stakeholder	Promoter
	Designer

	Fixture-structure engineer
	Main contractor (builder)
	Subcontractor (craft)
	Consultant
	Other: _____
Operation scale	Region
	Country
	Europe
	World-wide
Size of enterprise (nr. Of workers)	< 10
	> 11 < 50
	> 51 < 100
	> 101 < 500
	> 250 < 500
	> 500
Project scale: Built area [m2]	< =500
	> 500 <= 1000
	> 1000 <= 2000
	> 2000 <= 5000
	> 10,000 <= 20,000
	> 20,000
Project scale: nr. Of dwellings	<= 10
	> 11 <= 50
	> 51 <= 100
	> 101 <= 500
	> 501 <= 1000
Renovation scope	Envelope - façade
	Envelope - roof
	Envelope - windows / shading
	Services - HVAC
	Services - Lighting
	Services - Plumbing
	Accessibility
	Structure
	Interior spaces
	Other: _____
	Project phases
Renovation design	
Performance analysis	

	Execution of renovation works
	Occupation and maintenance
Experience in construction rehabilitation	< 2 years
	< 5 years
	< 10 years
	< 20 years
	> 20 years

Table 2 Data obtained from a company

5.1.2 BIM-SPEED BIM Maturity Index

The BIM-SPEED version of the BIM maturity index is inspired from three existing methods, the BIM Quick-Scan method (the Netherlands), the BIM Maturity Metric (Germany) and the BIM Maturity Index from the BIM Initiative (Australia). Accordingly, the partners of T2.1 managed to develop a BIM-SPEED Maturity questionnaire with the following characteristics.

- The structure of each chapter, the sub-chapters and some of the questions are taken from the BIM Quick-Scan method and the BIM Maturity Index.
- The questionnaire consists of 50 questions in total, clustered in 4 chapters and 13 sub-chapters, which are relevant to approach and check the level of BIM maturity of the stakeholder.
 - Policies (organization and management)
 - Organizational policies
 - Contractual policies
 - Preparatory
 - People (mentality and culture)
 - Roles and responsibilities
 - Qualification and skills
 - Communication and exchange
 - Working environment
 - Processes (information structure and flow)
 - Information structure
 - Information flow
 - Working practice
 - Technology (tools & applications)
 - Software
 - Hardware
 - IT security
- The full questionnaire is presented in [Appendix 1](#).
- The reason for limiting the number of questions to 50 is to avoid a lengthy and complicated questionnaire.
- The scoring system is taken from the BIM Maturity Metric, a fixed system ranging from 0 to 5. The lowest score 0 corresponds to “Not available” and the highest 5 corresponds to “Optimized”.
- There are questions with open answers to allow circulating feedback from the users.

- The maturity levels are taken from the BIM Maturity Index.
 - 0: Not available
 - 1: Identified (initial)
 - 2: Concept done (defined)
 - 3: Managed (tested)
 - 4: Implemented (integrated)
 - 5: Optimized
- Most of the questions are developed by the partners of T2.1
- The weights are relative within each subchapter, meaning the sum of weights within each sub-chapter should equal to 100%
- Multiple results are calculated and presented to the stakeholders; the results are categorized into:
 - Result per Topic.
 - Result per Aspect.
 - In addition to a data chart that allows you to compare the different maturity levels.

5.1.2.1 How is it Calculated?

- **Methodology**

As mentioned above, the questionnaire consists of 50 questions in total, clustered in 4 chapters and 13 sub-chapters, which will act as the assessment criteria, these Multiple-choice questionnaires will act as KPI, each sub-chapter has a maximum value of 100%, which is distributed evenly according to the answers given and according to the total number of questions per sub-chapter.

- **RESULTS AND REPORT**

A **Radar chart** is an informative visual tool in which multiple variables (three or more) and compared on a two-dimensional plane. For this, we will create different axes emerging from a common central point. In most of the cases, all the axes are equally distributed and uniformly drawn from each other. The axes are also connected to each other to form different grids that make it easier for us to plot the radar chart. **Radar charts** are considered as a better alternative to column charts as they can depict multiple variables easily without creating a clutter.

The maturity result acquired from the questionnaire is mapped into the **Radar chart**, the chart is sub-categorized into 7 axes; Preparatory, Contractual Policies, Organizational Policies, Working Environment, Communication & Exchange, Qualification & Skills, Roles & Responsibilities; and according to the maturity result, the chart will plot a sequence of equiangular spokes, called radii, with each spoke representing one of the variables. The data length of a spoke is proportional to the magnitude of the variable for the data point relative to the maximum magnitude of the variable across all data points.

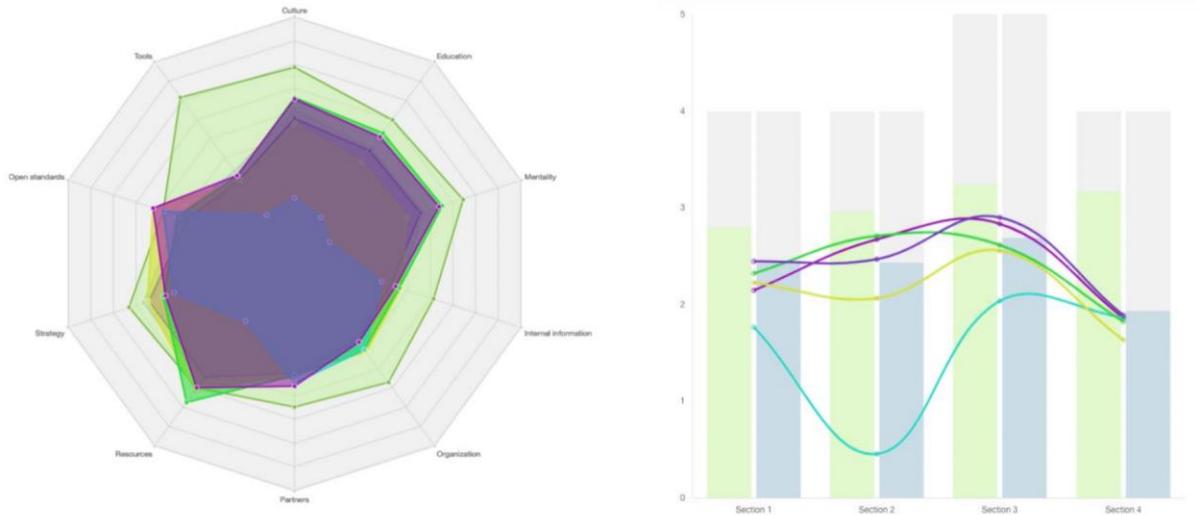


Figure 4 Radar Chart compared to Bar Chart Example

5.2 Project Part

5.2.1 Identification of Use Cases

As mentioned above, one of the objectives of the online survey is to provide stakeholders with proposals for appropriate BIM use cases to facilitate the implementation of BIM in renovation projects. These proposed BIM use cases will be provided by the online tool based on the maturity level of the stakeholder and the identified main objectives for the project defined by the stakeholder as input for the online survey. To get a clear understanding about what this means in detail, it is most important to clarify the used terminology in advance. BIM-SPEED's common understanding is provided in Figure 5.

Differentiation

- **Renovation goals:**
...aim to be achieved (e.g., reducing energy consumption)
- **Business processes:**
...task to be performed in design and construction projects (e.g., energy analysis)
- **BIM use case:**
...Application of BIM to support business process (e.g., BIM based energy analysis)
- **Methods:**
..The way of working to serve BIM use cases (e.g., transfer BIM to BEM)
- **Framework:**
...Organization, technical and legal requirements to run business processes

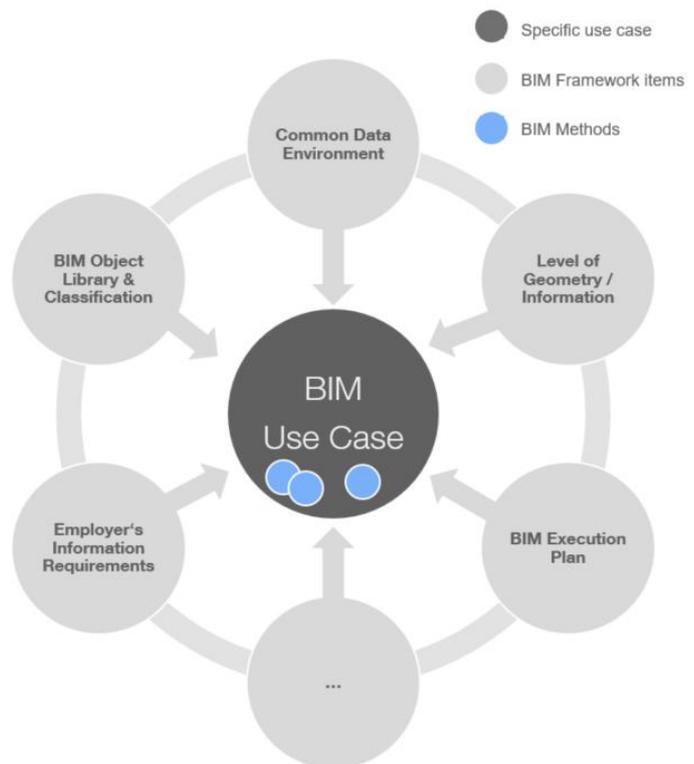


Figure 5 BIM-SPEED terminology

The **renovation goals** describe the main result of what should be achieved by implementing BIM on the specific renovation process. **Business processes** are common processes in the construction industry, which are performed to specific business goals. **BIM use cases** can be identified by applying BIM methodologies to support those business processes. The **methods** define the optional techniques, which can be applied to implement such a BIM use case. Finally, the **requirements** for successfully implementing those BIM use cases can be derived from the chosen methods.

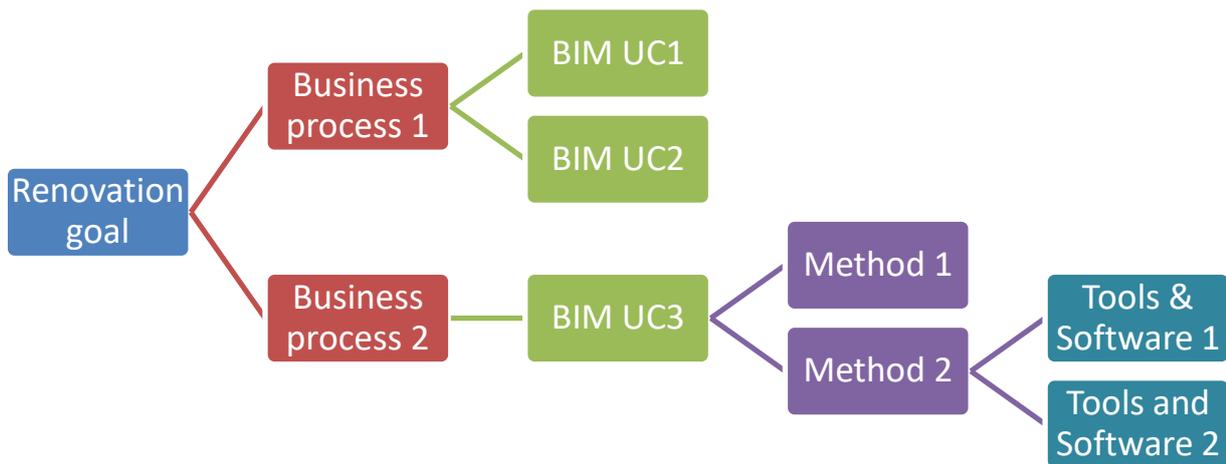
This definition of terminology enables two different approaches how to analyse the given input towards the online survey:

Requirements Approach

Top-Down-Approach

What are the requirements to reach a specified goal?

Figure 6 Top-Down Approach



Feasibility Approach

What can be achieved with available tools and data?

Bottom-Up-Approach

Figure 7 Bottom-Up Approach

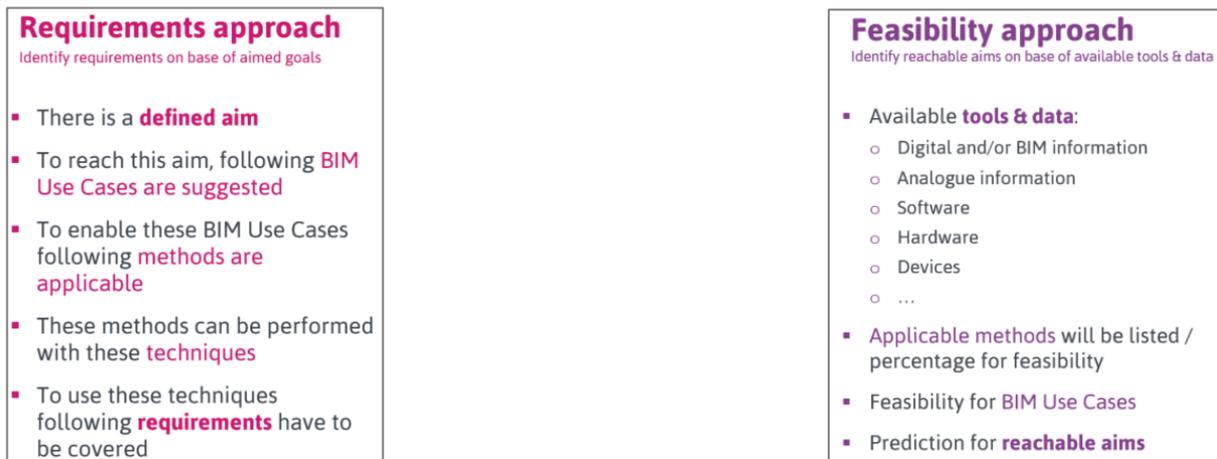


Figure 8 Requirement's approach vs Feasibility approach

The **Top-Down-approach** ("Requirement's approach") starts from the given aim and derives possible BIM use cases to achieve this goal. By mapping methods to these BIM use cases, it is possible to identify requirements, which must be fulfilled to enable BIM implementation. On the other hand, there is the **Bottom-Up-approach** ("Feasibility approach"), which starts by analysing available tools and given information about the renovation project. Based on this information feasible BIM use cases can be identified, which possibly leads to a prediction of the reachable goals.

Since the **Bottom-Up-approach** requires a solid base of information about all available tools on the market and their provided methods to support BIM use cases, it seems less productive to start bottom-up. Work Package 2 (**WP2**) took the decision to apply the **Top-Down-approach** to implement the online survey tool. Regarding the use case, the partners of this deliverable agreed on adopting 6 BIM use cases from the 20 use cases developed in **WP4** as a first starting point to develop the tool. The agreed-on use cases within the scope of this online tool are:

UC2: Assessing building energy performance with simulated data

UC4: Assessing thermal comfort with simulated data

UC6: Assessing acoustic comfort with simulated data

UC8: Assessing the as-built indoor air quality with simulated data

UC10: Lighting and visual comfort analysis with simulated data

UC16: Assessing operational energy cost and payback (simulated)

5.2.2 Project Questionnaire

The project questionnaire compiles information to link the project to the BIM use cases which could potentially be applied by the user. The questionnaire is divided into three main areas (General information, User, Project) – see **Table 3**.

General information	Project Title	
	Location	Street
		Number
		Post code
		City
		Province/State
		Country
	Role	Client/developer
		Architect/Designer
		Site Manager
		BIM Manager
		Engineer (thermal)
		Other Consultant
		Main Contractor (Builder)
Subcontractor (crafts)		
Supplier (construction component)		
Other: _____		
Ownership	Public	
	Private	
Technical information Project	Building typology	Multi-family dwelling
		Single-family dwelling
		High-rise apartment block
		Terraced/row house
		Historic building
	Project scale: Budget [mill. €] (Approx.)	<= 0.1
		> 0.1 <= 0.5
		> 0.5 <= 1
		> 1 <= 2
		> 2 <= 10
		> 10
	Project scale: Built area [m2]	<= 500
		> 500 <= 1000
		> 1000 <= 2000
		> 2000 <= 5000
		> 10,000 <= 20,000
		> 20,000
	Project scale: Nr. Of dwellings	<= 10
		> 11 <= 50
> 51 <= 100		

		> 101 <= 500
		> 501 <= 1000
	Renovation scope	Envelope - façade
		Envelope - roof
		Envelope - windows / shading
		Services - HVAC
		Services - Lighting
		Services - Plumbing
		Accessibility
		Structure
		Interior spaces
		Other: _____
	Project phases	Data acquisition
		Renovation design
		Performance analysis
Execution of renovation works		
Occupation and maintenance		
Renovation aim		

Table 3 Data obtained for a project

All of the above project questions do not have any effect on generating the use cases. The data will be stored to serve T5.4 in producing BIM procurement strategies. For the moment, as explained in chapter 5.2.3, the use cases will be generated depending on identifying the renovation goals and renovation business processes.

5.2.3 Mapping Project Questionnaire to BIM Use Cases

The project questionnaire is meant to lead the user to the adequate use cases which are supposed to serve the purpose of the project. The base of suggesting a use case is the information contained within each use case. Therefore, the questions should ask about the information within each use case. Plus, the implementation should be generic to allow modification in later stages of the project. For this purpose, a question tree, as shown in [Figure 9](#), [Figure 10](#) and [Figure 11](#), is suggested. The most important part of this tree is that the last level should always be renovation business processes.

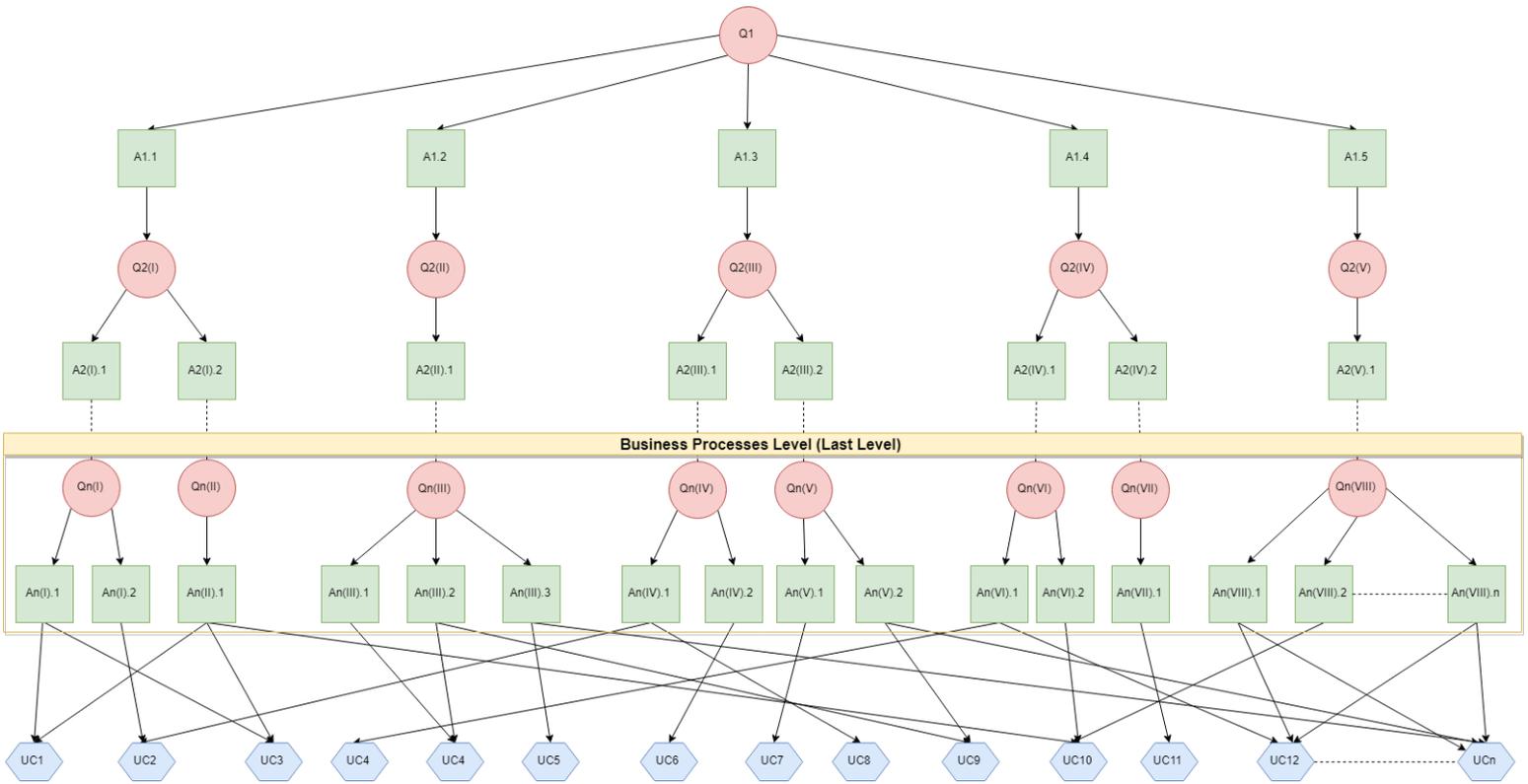


Figure 9 Question Tree

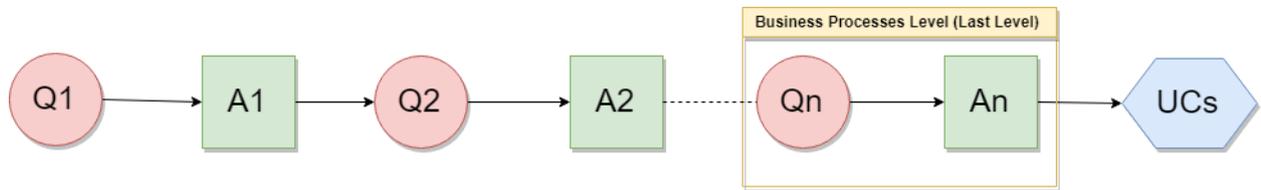


Figure 10 Generic tree path

Within the scope of this implementation, at first two questions are implemented to lead to the use cases, the renovation goal and the intended business processes. This will be extended throughout the project.

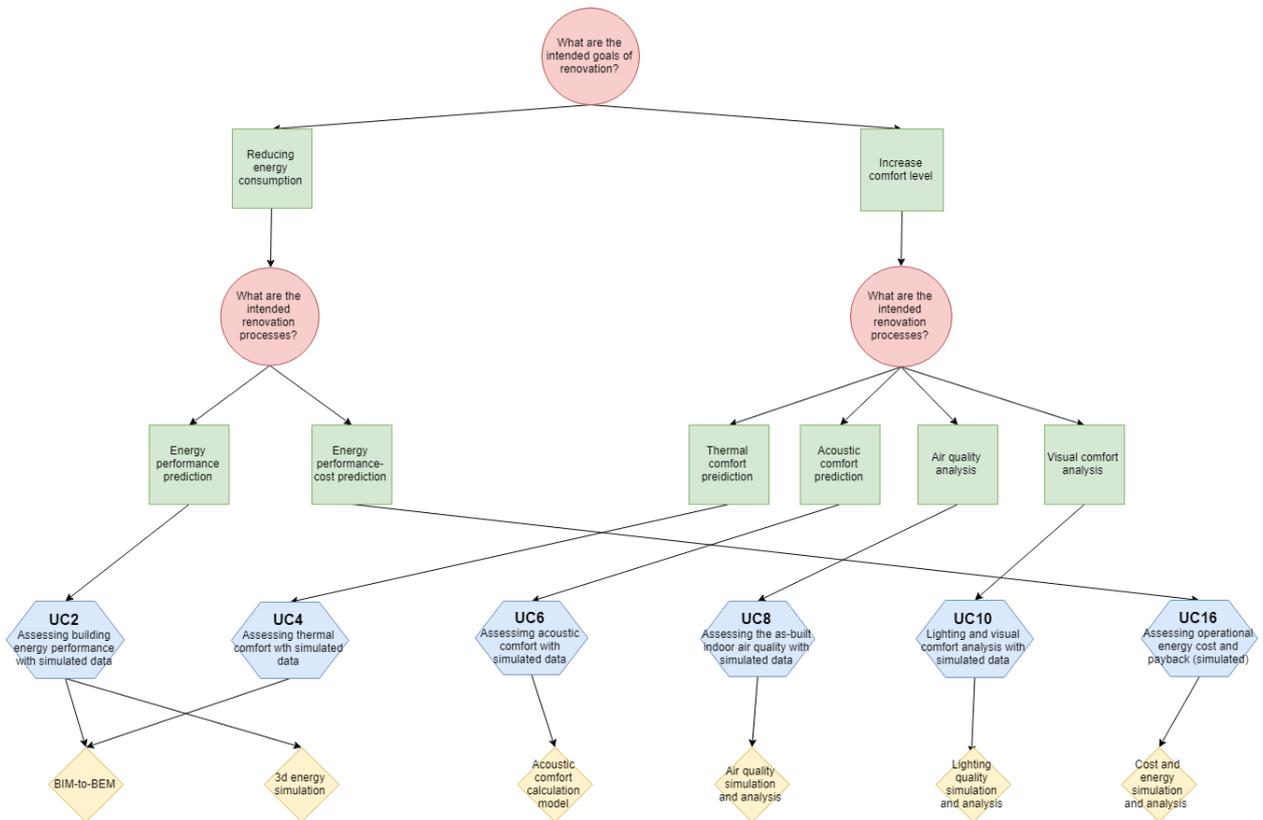


Figure 11 Simplified tree

The rest of the information related to the use cases are presented within a “container”. This container includes the title of the use case, the goal, a short description, the phases it should be applied to, the preconditions, and methods (BIM best practices) to achieve the specific use case. The feasibility of the use case is demonstrated by plotting the recommended maturity of the use case on top of the level of BIM maturity of the company, namely the BIM maturity calculated according to the latest scan. Figure 12 shows a sample use case.

UC2

Title

Assessing building energy performance with simulated data

Goal

Reducing energy consumption

Description

The use case provides a procedure to obtain the energy model of the building (BEM) which provides the energy performance assessment. The UC specifies the steps to move from the real building to the virtual building:

1. Geometrical and systems data
2. BIM modelling
3. BIM-to-BEM approach
4. BEM modelling

Phases to apply

- Performance Analysis (BIM-SPEED Stages)
- S3-S4 (RIBA)

Pre-conditions

1. Dwelling or similar use
2. Availability of building location and features information

Methods to achieve the use case

- BIM to BEM
- Performing 3D-energy simulation

Figure 12 Use Case Container – example UC2

Each BIM method is represented in a different container that shows the information related to the method. The required input is shown as a list of requirements. **Figure 13** demonstrates the container of the BIM method of BIM-to-BEM.

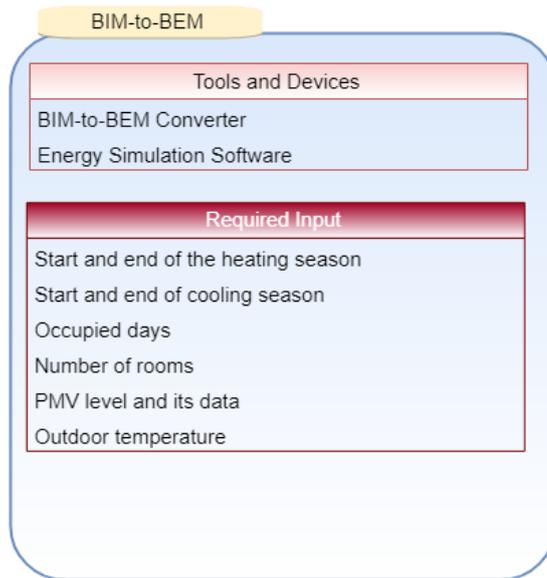


Figure 13 Information container related to the BIM method - example BIM-to-BEM

6. Online Tool Output

6.1 Feasibility of BIM Use Cases

Each use case will define the recommended level of BIM maturity corresponding to the sub-chapters of the BIM Speed Maturity Questionnaire. This way, the user will be able to compare the feasibility of different use cases and decide upon the most appropriate ones. The comparison will be available visually by plotting the required maturity for each use case over the BIM maturity level of the company in a single radar diagram. **Figure 14** shows an example of the feasibility of using **UC2**. The company's BIM maturity level is automatically derived from the most recent scan the user has taken.

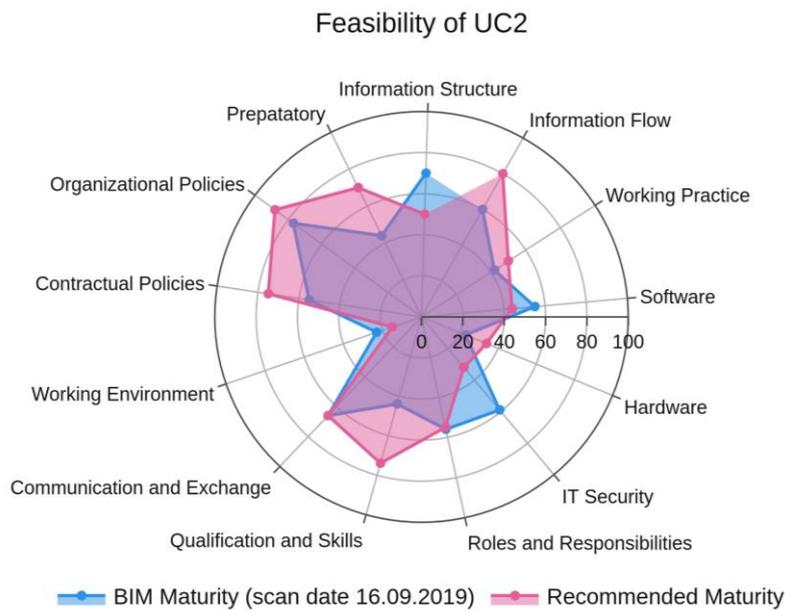
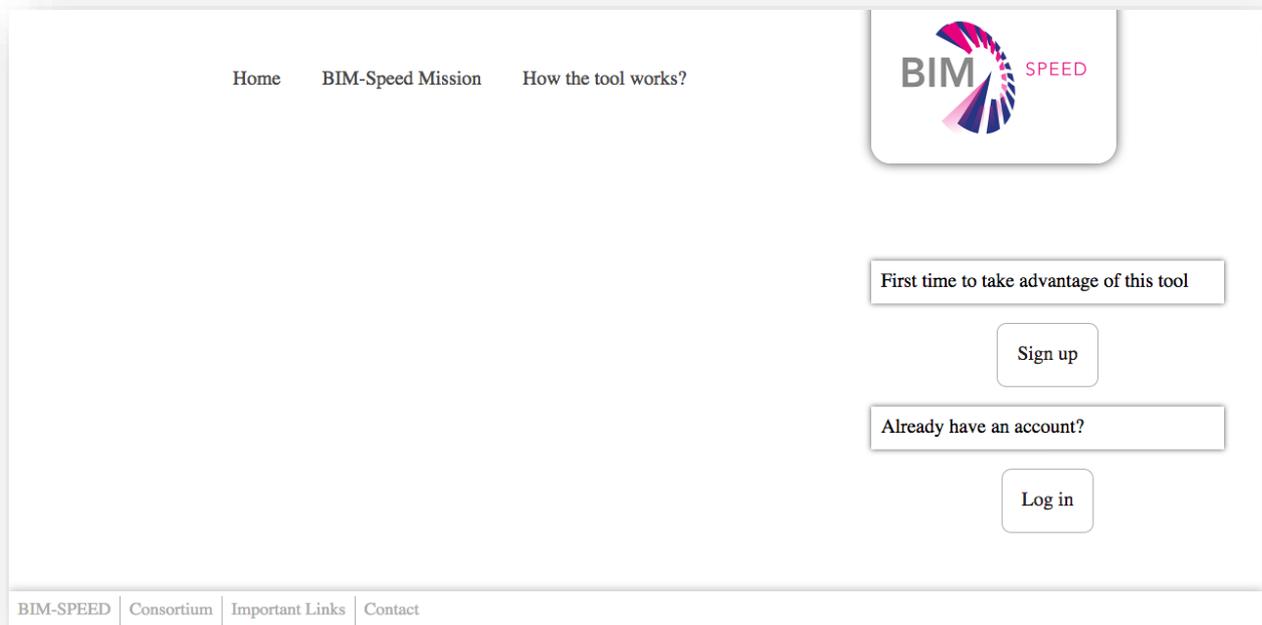


Figure 14 Example of the feasibility of using UC2

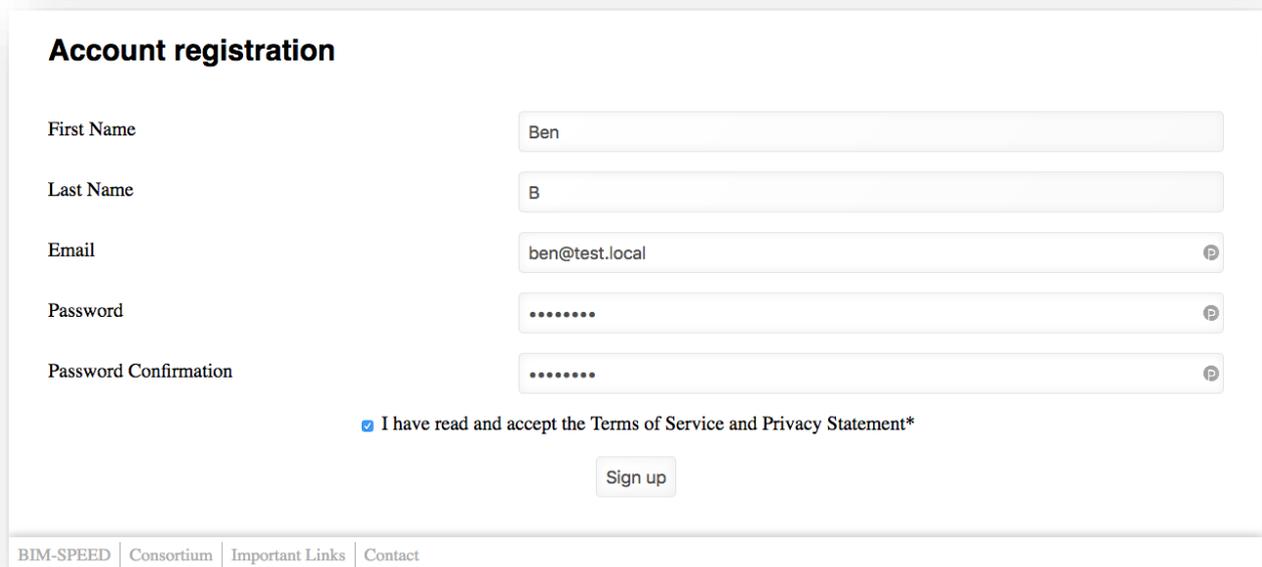
7. Implementation

This chapter documents the developed online tool in the form of screenshots.



The screenshot shows the external landing page for BIM-SPEED. At the top, there is a navigation menu with links for "Home", "BIM-Speed Mission", and "How the tool works?". On the right side, there is a logo for "BIM SPEED" featuring a colorful circular graphic. Below the logo, there are two main sections: "First time to take advantage of this tool" with a "Sign up" button, and "Already have an account?" with a "Log in" button. At the bottom, there is a footer with links for "BIM-SPEED", "Consortium", "Important Links", and "Contact".

Figure 15 External Landing page



The screenshot shows the account registration page. The title is "Account registration". There are five input fields: "First Name" (filled with "Ben"), "Last Name" (filled with "B"), "Email" (filled with "ben@test.local"), "Password" (filled with "....."), and "Password Confirmation" (filled with "....."). Each input field has a small "P" icon on the right. Below the input fields, there is a checkbox labeled "I have read and accept the Terms of Service and Privacy Statement*" which is checked. At the bottom, there is a "Sign up" button. At the bottom of the page, there is a footer with links for "BIM-SPEED", "Consortium", "Important Links", and "Contact".

Figure 16 Registration page



Account registration

Sign up successful! To complete your registration, please confirm the email sent to you.

Figure 17 Registration successful page



Confirm

You successfully confirmed your email address - your account is now ready to be used.

▶ [Go to start page](#)

Figure 18 Registration email confirmed page



Login

Email

Password

[▶ Forgot password?](#)

Figure 19 Login page



Functions

Welcome Ben B!

- [▶ Go to start page](#)
- [▶ Log out](#)

Settings

- [▶ Personal settings](#)
- [▶ Company settings](#)

Company Information

- [▶ BIM Maturity](#)
- [▶ Projects](#)

Figure 20 Internal landing page after login

Functions

- ▶ [Go to start page](#)
- ▶ [Log out](#)

Settings

- ▶ [Personal settings](#)
- ▶ [Company settings](#)

Company Information

- ▶ [BIM Maturity](#)
- ▶ [Projects](#)

Personal Settings

Change Password

Current Password

New Password

New Password Confirmation

Change Email

New Email

Current Password

[BIM-SPEED](#) | [Consortium](#) | [Important Links](#) | [Contact](#)

Figure 21 Internal personal settings page

Functions

- ▶ [Go to start page](#)
- ▶ [Log out](#)

Settings

- ▶ [Personal settings](#)
- ▶ [Company settings](#)

Company Information

- ▶ [BIM Maturity](#)
- ▶ [Projects](#)

Company settings

Name

Body

Activity Fields
Multiple options possible

Other Activity Fields

Street

Number

ZIP Code

[BIM-SPEED](#) | [Consortium](#) | [Important Links](#) | [Contact](#)

Figure 22 Internal company settings page

Home BIM-Speed Mission How the tool works?



Functions

- ▶ [Go to start page](#)
- ▶ [Log out](#)

Settings

- ▶ [Personal settings](#)
- ▶ [Company settings](#)

Company Information

- ▶ [BIM Maturity](#)
- ▶ [Projects](#)

BIM Maturity Overview

List of scans

No scans done so far

BIM-SPEED | Consortium | Important Links | Contact

Figure 23 Company BIM Maturity overview page

BIM Maturity Questionnaire

You answered 0 of 22 questions (0.00%).

1 POLICIES (Organization & Management)

1.1 Organizational Policies

		Does your organization use open standards to communicate with external partners ?					
		Never	From time to time	Yes but only a few of them are really open standards	Yes we use both open and private standards	Yes most of them are open standards	We are fully based in open standards
1	External communication	●	●	●	●	●	●
		Does your organization have general BIM standards ?					
		Not available	There is an initial idea	The general concept of some standards is	We are testing several standards	Yes they are implemented	Yes they are already optimized
2	BIM Vision and general plans	●	●	●	●	●	●

BIM-SPEED | Consortium | Important Links | Contact

Figure 24 Company BIM Maturity questionnaire page - example

You answered 22 of 22 questions (100.00%). Abort Continue later Finish

1	External communication	Never	From time to time	Yes but only a few of them are really open standards	Yes we use both open and private standards	Yes most of them are open standards	We are fully based in open standards
2	BIM Vision and general plans	Does your organization have general BIM standards ?					
		Not available	There is an initial idea	The general concept of some standards is clear	We are testing several standards	Yes they are implemented	Yes they are already optimized
3	BIM Vision and general plans	Is there any BIM Implementation-Plan or a general strategy on enterprise level available?					
		Not available	There is an initial idea	The general concept of the plan is clear	We are testing the plan	It is already implemented	It is optimized
		Are there channels to communicate and understand the BIM vision by staff?					

BIM-SPEED | Consortium | Important Links | Contact

Figure 25 Company BIM Maturity questionnaire page - example

Home | BIM-Speed Mission | How the tool works?



Functions

- ▶ Go to start page
- ▶ Log out

Settings

- ▶ Personal settings
- ▶ Company settings

Company Information

- ▶ BIM Maturity
- ▶ Projects

BIM Maturity Overview

List of scans

Scan Nr. 001 / 2019-09-30 15:24:50 ▶ View answers ▶ View results

BIM-SPEED | Consortium | Important Links | Contact

Figure 26 Company BIM Maturity questionnaire done page



BIM Maturity Result

[▶ Back to overview](#)

Company Info

Name	Test Company
Address	Test Street 100a
City	Test City

Figure 27 BIM Maturity result page (1/3)

Result per Topic

Section 1: POLICIES (Organization & Management)	33.04%
Section 2: PEOPLE (Mentality & Culture)	55.04%

Result per aspect

Organizational Policies	27.04%	Concept done
Contractual Policies	42.04%	Managed
Preparatory	30.04%	Concept done
Roles and Responsibilities	50.04%	Managed
Qualification and Skills	30.04%	Concept done

Figure 28 BIM Maturity result page (2/3)

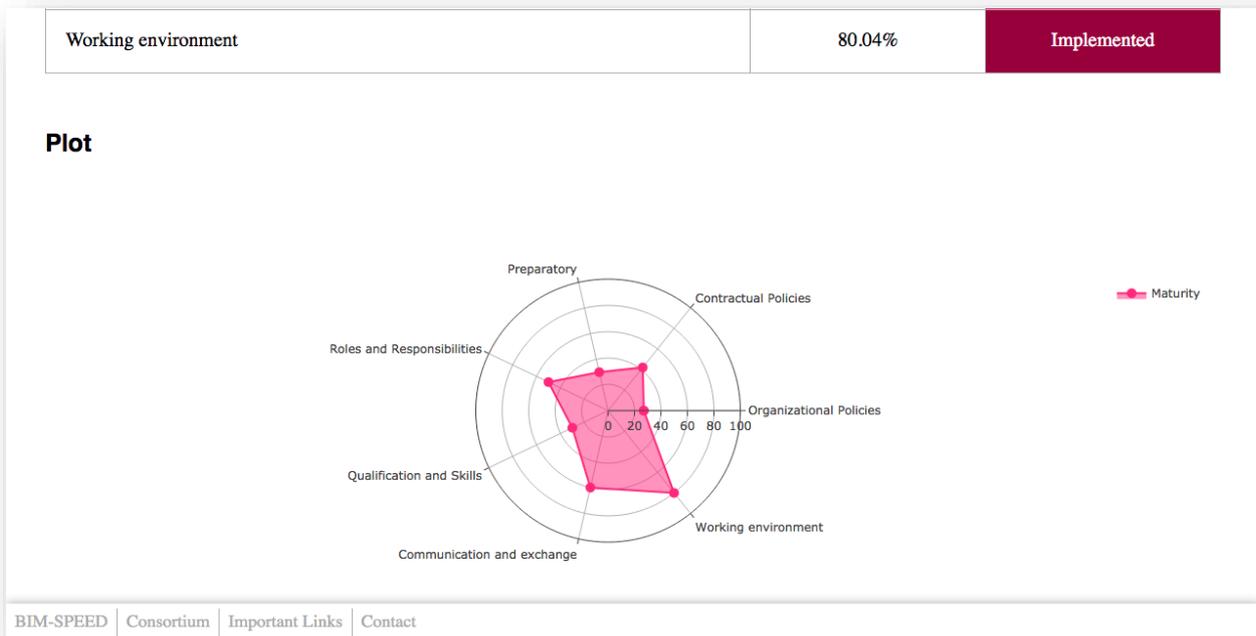


Figure 29 BIM Maturity result page (3/3)

Home | BIM-Speed Mission | How the tool works?

Functions

- ▶ Go to start page
- ▶ Log out

Settings

- ▶ Personal settings
- ▶ Company settings

Company Information

- ▶ BIM Maturity
- ▶ Projects

Projects Overview

List of projects

No projects created so far

[New Project](#)

BIM-SPEED | Consortium | Important Links | Contact

Figure 30 Projects overview page

Functions

- ▶ [Go to start page](#)
- ▶ [Log out](#)

Settings

- ▶ [Personal settings](#)
- ▶ [Company settings](#)

Company Information

- ▶ [BIM Maturity](#)
- ▶ [Projects](#)

Project Settings

Project Number

Name

Address

Street Number

ZIP Code City

Province / State Country

Project Details

[BIM-SPEED](#) | [Consortium](#) | [Important Links](#) | [Contact](#)

Figure 31 Projects create page

[Home](#) [BIM-Speed Mission](#) [How the tool works?](#)



Functions

- ▶ [Go to start page](#)
- ▶ [Log out](#)

Settings

- ▶ [Personal settings](#)
- ▶ [Company settings](#)

Company Information

- ▶ [BIM Maturity](#)
- ▶ [Projects](#)

Projects Overview

List of projects

name	creation time	options
ID-0001 / This is an example project name	2019-09-30 15:29	<ul style="list-style-type: none"> ▶ edit project ▶ view usecases

[BIM-SPEED](#) | [Consortium](#) | [Important Links](#) | [Contact](#)

Figure 32 Projects overview page - after project creation

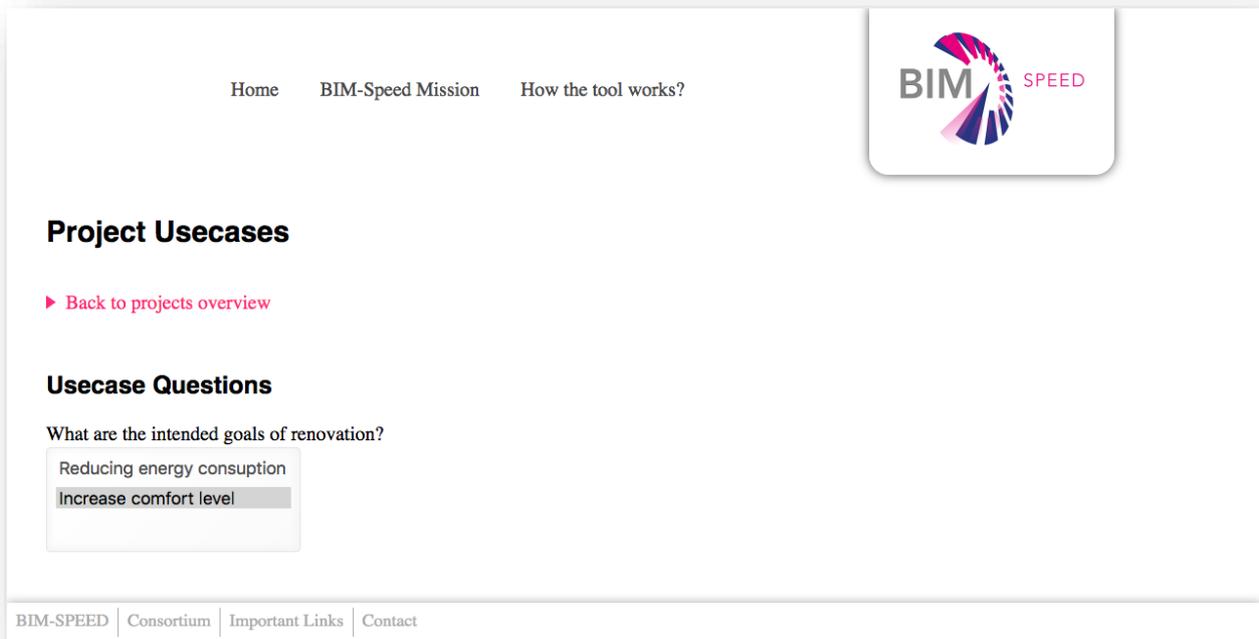


Figure 33 Project questionnaire / use case page (1/3)

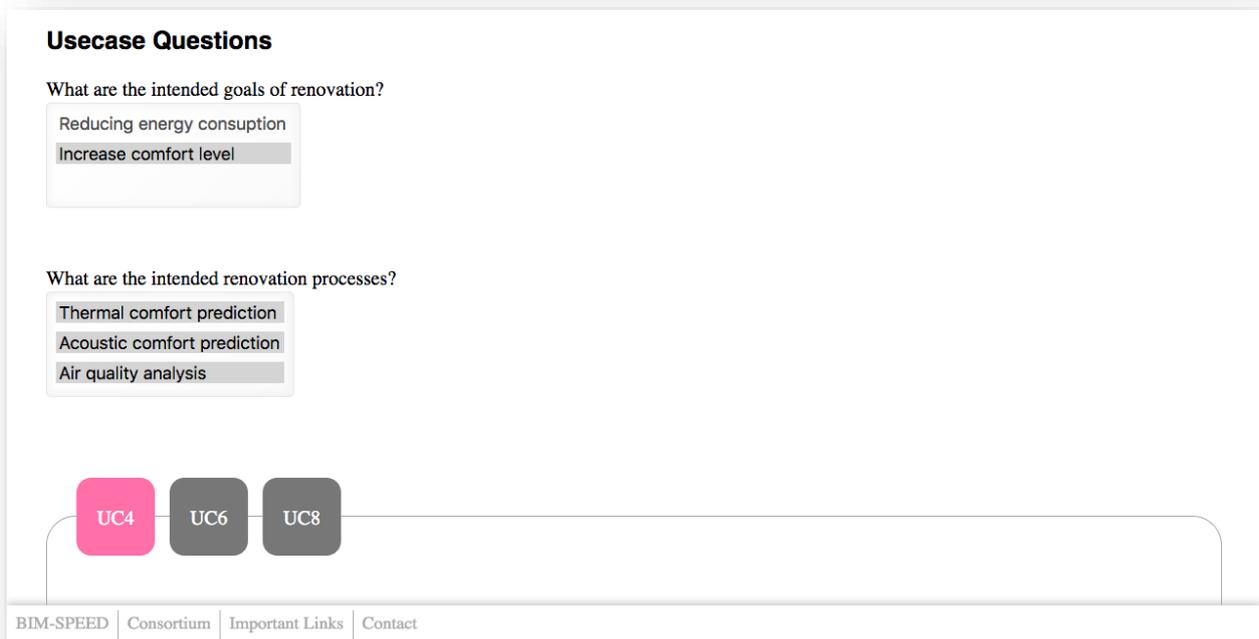


Figure 34 Project questionnaire / use case page (2/3)

UC4
UC6
UC8

Title

Assessing thermal comfort with simulated data

Goal

Increase comfort level

Description

The use case provides a methodology for evaluating the thermal comfort, using simulated data, under different conditions:
 The use case provides a methodology for

Category	Maturity (Pink)	Usecase (Blue)
Preparatory	~40	~50
Contractual Policies	~30	~40
Organizational Policies	~20	~80
Working environment	~60	~40
Communication and exchange	~30	~40
Qualification and Skills	~30	~50
Roles and Responsibilities	~40	~70

BIM-SPEED
Consortium
Important Links
Contact

Figure 35 Project questionnaire / use case page (3/3)

8. References

Although the references given below were not referenced in the report itself, they were used when processing Task 2.1:

1. Borrmann, M. König, M. Hochmuth, T. Liebich, and R. Elixmann, "Die INFRABIM-Reifegradmetrik: Formale Bewertung des Reifegrads von BIM-Pilotvorhaben," Bautechnik, vol. 94, no. 4, pp. 215–219, Apr. 2017.
2. Chengke Wu, Bo Xu, Chao Mao, Xiao Li. (2017). "Overview of BIM maturity measurement tools." Journal of Information Technology and Construction (ITCon). Vol 22. Pp 34-62, <http://www.itcon.org/2017/3>
3. EUBIM TASK Group. (2019). "Handbook for the introduction of Building Information Modeling by the European Public Sector." . www.eubim.eu
4. L. Joblot et al. (2019). Automation in Construction 101, pp 140-159.
5. L. Joblot et al. (2017). "Literature review of Building Information Modeling (BIM) intended for the purpose of renovation projects". IFAC PapersOnLine 50-I, pp 10518-10525.
6. Kreider, Ralph G. And Messner, John I. (2013). "The Uses of BIM: Classifying and Selecting BIM Uses". Version 0.9, September, The Pennsylvania State University, University Park, PA, USA. <http://bim.psu.edu>.
7. McAuley, B., Hore, A. And West, R. (2017) Irish BIM Study 2017, Irish Building Magazine, Iss 1, pp 77-79, 2017.
8. R. Sebastian and L. Van Berlo, "Tool for Benchmarking BIM Performance of Design, Engineering and Construction Firms in The Netherlands," Architectural Engineering and Design Management, vol. 6, no. 4, pp. 254–263, Jan. 2010.
9. Smits , Wim. Van Buten, Marc ,and, Hartmann, Timo.(2017). "Yield-to-BIM: impacts of BIM maturity on project performance". Building Research & Information, 45:3, 336-346, DOI: 10.1080/09613218.2016.1190579. <http://dx.doi.org/10.1080/09613218.2016.1190579>
10. J. Underwood and U. Isikdag, Eds., Handbook of Research on Building Information Modeling and Construction Informatics: Concepts and Technologies. IGI Global, 2010.

BIM web resources:

1. www.esbim.es
2. www.buildingsmart.org
3. www.buildingsmart.es
4. www.bimexcellence.org
5. www.bimdictionary.com
6. www.bimsupporters.com
7. www.bim.psu.edu
8. www.eubim.eu
9. www.bimquickscan.nl
10. <http://www.bimireland.ie/>

BIM Maturity web resources:

1. www.bimsupporters.com/tools/bim-quickscan
2. www.bimexcellence.org/resources/300series/301
3. <https://bimexcellence.org/projects/macro-adoption/macro-spain/>

9. APPENDIX 1 – BIM-SPEED - BIM Maturity Questionnaire

POLICIES (Organization & Management)								
1	Organizational Policies							
	1	External communication	Does your organization use open standards to communicate with external partners?					
	1		Never	From time to time	Yes, but only a few of them are really open standards	Yes, we use both open and private standards	Yes, most of them are open standards	We are fully based in open standards
			0	1	2	3	4	5
	2	BIM Vision and general plans	Does your organization have general BIM standards?					
	2		Not available	There is an initial idea	The general concept of some standards is clear	We are testing several standards	Yes, they are implemented	Yes, they are already optimized
			0	1	2	3	4	5
	3	BIM Vision and general plans	Is there any BIM implementation plan or a general strategy on organization level available?					
	3		Not available	There is an initial idea	The general concept of the plan is clear	We are testing the plan	It is already implemented	It is optimized
			0	1	2	3	4	5
	4	BIM Vision and dissemination	Are there any channels to communicate your BIM vision with your staff?					
	4		Not really	There are some channels, but not specific	Yes, there are, but we do not use them	Yes, there are, but we almost do not use them	Yes, there are and they work	Yes, they are optimized
			0	1	2	3	4	5
	5	Process-Manuals	Do you have BIM Process-Manuals to introduce BIM on development-level?					

	5		Not really	We have started with the idea	We are developing the first manuals	Yes, there are some, but not for all the Departments	Every Department has one	Yes, and the process has been optimized
			0	1	2	3	4	5
	6	Quality concept	Are there any quality control measures in place for data?					
	6		Not really	We have started with the idea	We are developing the first checkpoints	Yes, we are testing them	Yes, we are already implementing them	Yes, and the process has been optimized
			0	1	2	3	4	5
2	Contractual Policies							
	7	Data security and property rights	Are data security and property rights defined in contractual documents?					
	1		No	Not yet, but we have identified several ones	Not yet, but we are working on the definition	Yes, but only in a few contracts	Yes, both in most contracts	Absolutely
			0	1	2	3	4	5
	8	Information management	Are the information flows between your organization and your (project) partners described/written down?					
	2		No	Not yet, but we have identified several ones	Not yet, but we are working on the definition	Yes, some of them	Yes, most of them	Absolutely
			0	1	2	3	4	5
	9	Information management	Availability of statements defining the responsibility of each stakeholder regarding information management					
	3		Not available	Identified=Initial	Concept done: Defined	Managed=tested	implemented=integrated	Optimized
			0	1	2	3	4	5
3	Preparatory							
	10	Training	Does your organization provide for structured external training of staff?					

	1		Not really	Not yet, but we are working on the definition	Yes, but not everybody has access to it	Yes, they provide us external training sometimes	Yes, they provide as external training quite often	Yes, and every post has a training roadmap
			0	1	2	3	4	5
	11	Training	Does your organization provide for structured internal training of staff?					
	2		Not really	Not yet but we are working on the definition	Yes, but not everybody has access to it	Yes, they provide us internal training sometimes	Yes, they provide as internal training quite often	Yes, and every post has a training roadmap
			0	1	2	3	4	5
OPEN FEEDBACK QUESTION			What does your organization expect from implementing BIM?					
			Open answer. Example: reduce time, reduce cost, provide better quality, avoid problems during the process, open new markets etc.					
PEOPLE (Mentality & Culture)								
1	Roles and Responsibilities							
	12	Roles	Are the roles clearly defined within your organization?					
	1		No	Not yet, but we have identified several ones	Not yet, but we are working on the definition	Yes, but only for several people or projects	Yes, for most of the people or projects	Absolutely
			0	1	2	3	4	5
	13	BIM roles	Are the BIM roles clearly defined within your organization?					
	2		No	Not yet, but we have identified several ones	Not yet, but we are working on the definition	Yes, but only for several people or projects	Yes, for most of the people or projects	Absolutely
			0	1	2	3	4	5
	14	Project roles	Are the team structures/dynamics consistent or performance is only depending on the employees "heroism"?					
	3		No idea	Absolute "Heroism"	Quite "Heroism"	Mixture of "Heroism" and consistency	Quite Consistent	Absolute Consistent

			0	1	2	3	4	5
	15	BIM responsible	Is there anyone within your organization who is the final responsible for effective and efficient work with BIM?					
	4		No idea	No	Probably yes	Yes, there is a person	Yes, there is an expert	Yes, there is the director of BIM department
			0	1	2	3	4	5
2	Qualification and skills							
	16	Training	Is there any training related to BIM tools for your staff?					
	1		Not really	Not yet, but we are working on the definition	Yes, but not everybody has access to it	Yes, on need based	Yes, periodically	Yes, and every post has a BIM training roadmap
			0	1	2	3	4	5
	17	Experience	What expertise/experience does your organization have in working with BIM?					
	2		No experience	Less than one year	Less than 2 years	More than 2 years	More than 5 years	More than 7 years
			0	1	2	3	4	5
	18	Experience	From 0 (lowest) to 5 (highest), which level of BIM maturity would assess for your organization?					
	3		0	1	2	3	4	5
			0	1	2	3	4	5
3	Communication and exchange							
	19	Collaboration channels	Are there channels or methods to transfer knowledge between staff members?					
	1		Not really	Not yet but we are working on the definition	Yes, but not everybody has access to it	Yes, on need based	Yes, periodically and perfectly defined	Yes, periodically and perfectly defined and we review them to improve
			0	1	2	3	4	5
	20	Feedback	Is there a mechanism to allow feedback from staff members on the information structure and BIM products in use?					

	2		Not really	Not yet, but we are working on the definition	Yes, but not everybody has access to it	Yes, on need based	Yes, periodically and perfectly defined	Yes, periodically and perfectly defined and we review them to improve
			0	1	2	3	4	5
4 Working environment								
	21	Strategic	Is there any strategy to improve the working environment as a factor of productivity?					
	1		Not available	Identified=initial	Concept done: Defined	Managed=tested	Implemented=integrated	Optimized
			0	1	2	3	4	5
	22	Tools	Do you have tools to control, manage, and modify the working environments to enhance staff motivation, satisfaction and productivity?					
	2		Not available	Identified=initial	Concept done: Defined	Managed=tested	Implemented=integrated	Optimized
			0	1	2	3	4	5
OPEN FEEDBACK QUESTION			Which challenges do you regard as the most critical in achieving large scale adoption of BIM for rehabilitation in your country?					
			Open answer: Example: clients unaware of the value proposition, lack of public sector real mandate, implementation of BIM in smaller companies, lack of BIM skills within current staff, initial cost of implementing BIM, issues regarding data ownership and liability, etc.					
PROCESSES (Information Structure & Flow)								
1 Information structure								
	23	Defined Information Requirements	Does your organization define the appropriate level of information needed in each project phase?					
	1		No	Not yet, but we have identified several ones	Not yet, but we are working on the definition	Yes, but not in every phase	Yes, it is precisely defined and integrated	Yes, they are and we have reviewed and implemented
			0	1	2	3	4	5
	24		Does your organization define the minimum parameterization level in the model?					

	2	Defined Information Requirements	No	Not yet, but we have identified several features	Not yet, but we are working on the definition of the features	Yes, it is for certain constructive elements only	Yes, it is precisely defined and integrated for elements and categories	Yes, they are and we have reviewed and implemented
			0	1	2	3	4	5
	25	Defined Information Requirements	Is there a quality checking process in place for importing new data in your dataset?					
	3		No	Not yet, but we have identified several features	Not yet, but we are working on the definition	Yes, it is and were testing if it works	Yes, it is precisely defined and integrated	Yes, there is and we have reviewed and implemented for BIM
			0	1	2	3	4	5
2	Information flow							
	26	Process-Manuals	Are the information flows within your organization described/written down?					
	1		Not available	There is an initial idea	The general concept of some standards is defined	We are testing several standards	Yes, they are implemented	Yes, they are already optimized
			0	1	2	3	4	5
	27	Collaboration-Manuals	Are the information flows between your organization and your (project) partners described/written down?					
	2		Not available	There is an initial idea	The general concept of some standards is defined	We are testing several standards	Yes, they are implemented	Yes, they are already optimized
			0	1	2	3	4	5
	28	Collaboration-Process	Do you define process maps for working on BIM models?					
	3		Not available	There is an initial idea	The general concept of the maps is defined	We are testing the maps	It is already implemented	It is optimized
			0	1	2	3	4	5
	29	Collaboration-Process	Do you involve OHS department in BIM processes?					

	35	Checking	Do you check the quality of BIM Models?					
	3		No	1-20%	21-40%	41-60%	61-80%	81-100%
			0	1	2	3	4	5
	36	Performance	Do you perform quantity take-offs based on BIM Models?					
	4		No	1-20%	21-40%	41-60%	61-80%	81-100%
			0	1	2	3	4	5
	37	Checking	Do you carry out clash detection on BIM Models?					
	5		No	1-20%	21-40%	41-60%	61-80%	81-100%
			0	1	2	3	4	5
	38	Strategic	Do you understand the Level Of Detail (LOD) required at each project phase?					
	6		No	1-20%	21-40%	41-60%	61-80%	81-100%
			0	1	2	3	4	5
	39	Strategic	Do you understand the Level Of Information (LOI) required at each project phase?					
	7		No	1-20%	21-40%	41-60%	61-80%	81-100%
			0	1	2	3	4	5
OPEN FEEDBACK QUESTION			Do you think it is possible to achieve BIM workflow and processes in your company in short term (2 years)? Why?					
			Open answer					
TECHNOLOGY (Tools & Applications)								
1	Software							
	40	Usability of software	From 0 (Totally disagree) to 5 (totally agree) do you agree to have the adequate software for aimed BIM use cases?					
	1		0	1	2	3	4	5
			0	1	2	3	4	5
	41	Interoperability	In which percentage does your organization work with IFC files (Open BIM)?					

	48	Interoperability	How secure do you consider your organization is in terms of data security?					
	2		0	1-20%	21-40%	41-60%	61-80%	81-100%
			0	1	2	3	4	5
	49	Knowledge infrastructure	Are network solutions for harvesting, storing and sharing knowledge, within and between organizations, well managed through common platforms?					
	3		Not available	Identified the need=Initial	Concept done: Defined what and how to use it	Managed=48estimating the use	The use is implemented=integrated	The use is optimized
			0	1	2	3	4	5
	50	Platforms	Does your organization actively use the Common Data Environment (CDE) platform within projects?					
	4		Not available	Identified the need=Initial	Concept done: Defined what and how to use it	Managed=48estimating the use	The use is implemented=integrated	The use is optimized
			0	1	2	3	4	5
OPEN FEEDBACK QUESTION			What BIM tools are you currently using?					
			Open answer. For Example: ArchiCAD, Revit, Vectorworks, Cype etc.					
OPEN FEEDBACK QUESTION			Is there any organization (Non-Profit) that provides general support for BIM in your country?					
			Open answer. Yes, for example the BIM Association.					

10. Appendix 2 - Revisions addressing monitor comments

1. Section 3.1 Workflow would be the method - thus should be presented separately, not as a sub-section of the tool structure (section 3)

- Method should be described with regard to the 2 parts considered "project" and "enterprise"

A separate chapter was added 'Chapter 2: Method', the method chapter briefly describes the work flow of the tool, the differentiation between the project part and the enterprise part is described in the figures presented in Chapter 2.1.

2. Objectives defined: 1) to determine the feasibility of using BIM for renovation projects and 2) to define the scope of BIM implementation for renovation projects

- Feasibility = provide guidance on which BIM use cases are best suited after considering the BIM maturity of the interested user and the project-specific information

- What about the "scope of BIM implementation" how is this to be interpreted? What output is expected regarding this objective?

Since the mentioned terms may give different meanings according to the user perspective, a clear definition of the Feasibility and Scope is defined and added into Chapter 4: Online Tool Objectives.

3. Use cases could've been defined separately or point to the pertaining deliverable, unsure if section 3.3. "Project Part" is really related to this deliverable 2.1

A separate chapter was added 'Chapter 3: BIM Use Cases', a clear presentation of the use cases is now presented to the user before discussing the online tool.

4. Do elements provided in Table 1 have specific weights? If yes, provide them and detail how are these used in the overall method?

Its already noted in 'Chapter 5.1.2: BIM – SPEED BIM Maturity Index' that there are no weights to the questions in the questionnaire, each subsection consist of different number of questions, and the calculation techniques requires the questions in the sub-section is to be equal 100%.

5. It is unclear how the scoring is computed, what is the exact relation among the replies provided to questionnaires (company and project) the outputs illustrated e.g., Figure 30

A new chapter is added 'Chapter 5.1.2.1: How is it calculated' where is gives a brief introduction of the calculation techniques.

6. Revise text formatting at beginning of section 3.3.3, add missing reference

Done